

# Coronary Computed Tomography Angiography—Noninvasive Modality in Assessing Coronary Artery Disease

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Invasive coronary angiography (CAG) is well recognized as the standard procedure in the study of coronary artery disease, especially to assess coronary artery patency or stenosis, and for the performance of therapeutic coronary intervention.<sup>1</sup> However, inconvenience to the patient, economic considerations of the procedure, and some incidence, albeit low, of associated complications have prompted the search for a noninvasive and safe alternative without sacrificing high diagnostic accuracy.

The recent development of multislice computed tomography (MSCT), from 4- to 16- and furthermore to 64-detector rows, has provided promising results in the evaluation of coronary disease by improved temporal and spatial resolution, and coronary computed tomography angiography (CCTA) makes “imaging a beating heart” possible.<sup>2</sup>

An increasing number of articles are reporting the diagnostic accuracy of CCTA, using CAG as the reference standard, in the evaluation of coronary artery stenosis. With adequate patient preparation to obtain a lower heart rate and breath-hold training, careful selection of image acquisition protocol to provide good image quality (high vessel signal-to-noise ratio and assessable rate), and after expert imaging interpretation, sensitivity of 95–97%, specificity of 69–97.6%, positive predictive value (PPV) of 79–93%, and negative predictive value (NPV) of 92–99.3% have been reported.<sup>3–5</sup>

In this issue of the *Journal of the Chinese Medical Association*, Han et al report the results of CCTA in the assessment of coronary artery stenosis, and the clinical applicability of this modality in the performance of CAG.<sup>6</sup> In their study, 53 patients were subjected to both CAG and CCTA, and a 345-patient cohort

underwent CCTA alone. Using CAG results as the reference standard, the authors found that CCTA allowed evaluation of coronary artery stenosis with sensitivity, specificity, PPV and NPV of 81%, 99%, 87% and 99%, respectively. Atheromatous plaques and congenital anomalies of the coronary artery were also well depicted. Their results are comparable to those of previous studies. Accordingly, CCTA may become an important imaging modality in the diagnosis of coronary artery diseases.

Radiation exposure has, however, long been criticized as an inherent drawback of CCTA.<sup>7</sup> Of interest is that the CCTA procedures in Han et al’s study were undertaken either before or after CAG, which is different from most study designs. Unwarranted radiation exposure should be a prime consideration when CCTA is performed shortly after CAG, and dose-reduction strategies, such as online ECG gated dose modulation, should be applied to minimize radiation exposure, as an overall 30–50% radiation dose reduction can be achieved without compromising image quality.

So far, there is no single modality that is perfect for assessing coronary artery diseases. CCTA can be applied as a gatekeeper before CAG due to its high NPV rate, especially when you consider the 20% NPV rate of CAG in daily practice.<sup>8</sup> If the CCTA result is negative, then reassurance that the risk of coronary artery stenosis is very low can be provided. CCTA is currently applied for: (a) detection and characterization of coronary artery occlusive lesions; (b) detection and characterization of coronary artery anomalies; and (c) detection and characterization of postoperative abnormalities.<sup>9</sup>

It has been reported that the capability of MSCT in assessing coronary artery stenosis can potentially



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be impaired by some factors, mainly heavy arterial calcification and inadequate opacification of small vessels that are less than 1.5 mm.<sup>10</sup> Heavy arterial calcification would result in an overestimation of stenosis and a decreased PPV, as seen in 9 of 795 segments (1.1%) in Han et al's series.<sup>6</sup> On the other hand, inadequate opacification of small or distal vessels would underestimate coronary stenosis; false negative results occurred in 8 of 795 segments (1%) in Han et al's study.<sup>6</sup>

Ongoing technical innovative improvements, including flat-panel and dual-energy technology and wide (256-, 320-) detector row arrangement, will further increase spatial and temporal resolution, enabling the discrimination of calcification from contrast-enhanced lumen.

Further technical improvements for CCTA are underway. In the near future, CCTA may become the modality of choice as a screening tool for coronary artery disease.

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